

Composite Shell/Nanoporous Organosilica Core-Multifunctional Structures, Phase I

Completed Technology Project (2007 - 2007)



Project Introduction

Planetary exploration presents challenges for mobility, fuel efficiency, payload weight management, robustness, and thermal as well as radiation protection. There is a need for lightweight structures in space transport, vehicle systems, instrumentation, planetary access, as well as operations including facilities and habitats. These vehicles, equipment, and structures will be subjected to rigorous environmental exposures and assaults. Innovations that increase specific strength and stiffness, reduce weight, provide radiation shielding, enhance thermal management, and improve robustness, in a safe, reliable, cost effective manner will contribute to the success of these missions. This proposal offers an innovative solution utilizing fundamental mechanical engineering principles taken to a multi-hierarchical level. Directionally oriented reinforced composites, structural foam, honeycomb, and core-shell designs are mature technologies. The distinguishing element of the approach for this proposal is the unique, new to the world, X-aerogel core material developed by NASA GRC. Aerogels are touted as the lowest-density solid materials known and have excellent insulation capacity but are extremely fragile. Through conformal polymer crosslinking of the silica structure, these sol-gel castings can be strengthened into the realm of load bearing materials at densities in the 0.2 to 0.3 g/cc range. Further, this proposal explores manipulation of the core material nanostructure through surfactant induced micelle formation. This will create controlled morphology nano-honeycomb, which is expected to greatly enhance the strength and reliability versus the sol-gel random nanofoam through elimination of stress concentrators and optimal distribution of load. When these cores are coupled with advanced composite skins, resulting structures are extremely lightweight with strength, stiffness, and insulation performance far beyond what is currently commercialized.



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Marshall Space Flight Center (MSFC)

Responsible Program:

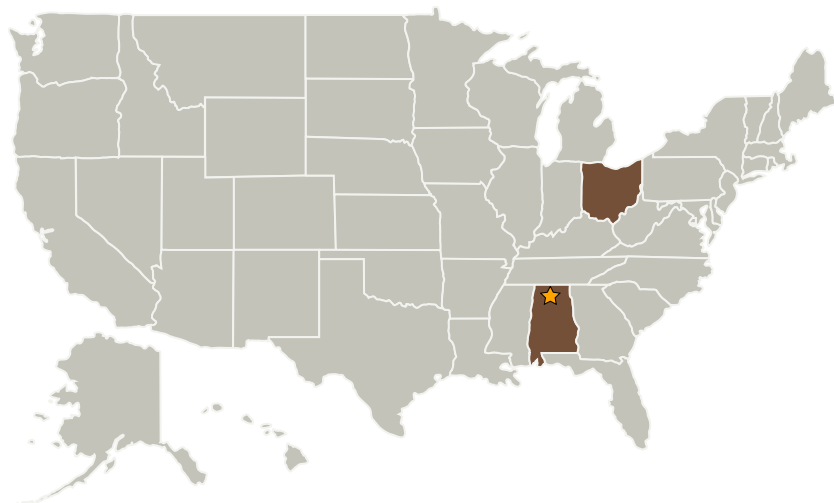
Small Business Innovation Research/Small Business Tech Transfer

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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Marshall Space Flight Center (MSFC)	Lead Organization	NASA Center	Huntsville, Alabama
Iten Industries, Inc.	Supporting Organization	Industry	Ashtabula, Ohio

Primary U.S. Work Locations

Alabama	Ohio
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Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
 - └ TX12.1 Materials
 - └ TX12.1.1 Lightweight Structural Materials